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EFFECT OF DEPTH OF PLANTING ON THE EMERGENCE OF BITTERBRUSH SEEDLINGS[1]

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Establishment of bitterbrush (Purshia tridentata) plants from seed under range conditions is a complicated undertaking that entails many critical factors. One of these factors is the depth at which the seed is planted. A study underway in California has shown that the optimum depth is dependent primarily on soil type and the amount and distribution of precipitation during the germination and emergence period. Consequently, there appears to be no single optimum for the species. However, seed broadcast on the soil surface or planted deeper than 2 inches have not produced satisfactory seedling stands.

In 1952, the California Forest and Range Experiment Station, in cooperation with the California Department of Fish and Game, began a study to find ways and means of reseeding bitterbrush on deteriorated winter deer ranges in northeastern California. One of the first problems to be attacked was the proper depth at which to plant the seed.

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[1] Contribution from cooperative investigation between the California Forest and Range Experiment Station and the California Department of Fish and Game. Work was done under Federal Aid in Wildlife Restoration Act, Pittman-Robertson Research Project W51R, entitled "Game Range Restoration."

The author acknowledges that this study was planned and designed by A. L. Hormay, Range Conservationist, California Forest and Range Experiment Station.

THE STUDY

Bitterbrush seed was planted at various depths on cultivated sites inside deer-livestock exclosures at three locations each fall from 1952 through 1954 and each spring from 1953 through 1955. All plantings were protected from rodents. The northernmost study area was Flukey Spring, in Modoc county on the winter range of the California-Oregon interstate deer herd. This area receives 12 to 14 inches of precipitation annually, the highest of the three. The second area, located near Doyle, California, about 45 miles north of Reno, Nevada, receives 9.5 inches annually. Wells Meadow, the southernmost area, is near Bishop, California, in a precipitation belt of 6 to 8 inches.

The soil at Flukey Spring is a sandy loam of basalt origin. At the other two locations, the soils are granitic in origin and loamy coarse sand in texture. The soil at Wells Meadow is coarser than that at Doyle.

The spot planting technique was used, with five seed in each spot. The first year, 50 seed were planted at each of 5 depths; the second year, 100 seed at each of 6 depths; and the third year, 500 seed at each of 9 depths.

Bitterbrush seed has a dormancy which prevents it from germinating without some kind of treatment to break the dormancy. The dormancy of fall-planted seed is broken naturally by overwintering in the soil. Spring-planted seed, however, must either be stratified in the laboratory in a moist media at temperatures between 32 and 41 degrees F. for a 5- to 8-week period[2] or be treated with thiourea, a chemical which artificially breaks the seed dormancy.[3] Seed planted in the springs of 1953 and 1954 was stratified in the laboratory, whereas that planted in the spring of 1955 was treated with thiourea.

Two inches was the greatest depth tested the first year of the study, but since some seedlings did emerge from that level, plantings were made to 3 inches the second year and to 4 inches the third year.

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[2] Hormay, August L. Bitterbrush in California. Calif. Forest and Range Expt. Sta. Res. Note 34, 13 pp., illus. 1943 (Processed).

[3] Pearson, Bennett O. Bitterbrush seed dormancy broken with thiourea. (Manuscript accepted for publication in Jour. Range Mngt.)

RESULTS AND DISCUSSION

Two inches seems about the maximum depth from which bitterbrush seedlings can be expected to emerge (table 1). A few were obtained from 2.5 inches at all areas and from 3.0 inches at Wells Meadow, but emergence from these depths was undependable. Practically no seedlings were obtained from broadcasting on the soil surface.

The best depths differed by years and sites (table 2.) The optimum ranges for 1953 were determined by inspection because the plantings made that year were too small for statistical treatment. The 1954 and 1955 data were tested by means of "t" tests to determine significant differences between emergence from the various depths.

The differences in optimum planting depth between locations are undoubtedly due to the influence of soil moisture and soil type. Soil moisture is influenced both by the speed at which the particular soil dries and the precipitation. Since both the soils and the precipitation during the different years (fig. 1) differed, it is not surprising that the optimum planting depths differed.

Soil moisture has a bearing first upon the effectiveness of stratification of fall-planted seed. If the seed dries during or after the stratification period, they will go back into dormancy. This may have happened in the fall of 1953 and caused the relatively low emergence from plantings made that season.

After the dormancy of bitterbrush seed has been broken, soil moisture must be ample at the seed level throughout the period of germination and emergence. There is some indication that thiourea-treated seed requires more moisture during this period than cold-stratified seed.

Although surface and very shallow plantings receive a high proportion of the natural precipitation they are also subject to greater temperature extremes and more rapid drying conditions. This is especially true on coarse textured soils. Therefore, it seems desirable to plant seed as deeply as possible within the optimum depth range of the given site. For example, emergence was good from seed planted at 0.5 and 1.0 inch at Flukey Spring during all 3 years of this study. However, emergence from 1.0 inch would be more likely under rapid drying conditions during the critical germination and early growth period. At Doyle, emergence was also good from both 0.5 and 1.0 inch and, again, the best planting depth would be 1.0 inch. At Wells Meadow with its low precipitation and coarse textured soil, which dries rapidly, emergence has been consistently good from 1.5 inches. This depth is recommended for this site even though good emergence has occurred from shallower depths during some years.

Table 1.--Emergence of bitterbrush seedlings from seed planted at specified depths, 1952-55

Experimental area and time of planting	Emergence where depth of planting (inches) was--								
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
	- - - - - Percent - - - - -								
Flukey Spring:									
Fall 1952	0	12	14	8	18	--	--	--	--
Spring 1953	0	32	44	52	64	--	--	--	--
Fall 1953	--	14	28	21	4	0	0	--	--
Spring 1954	--	43	56	19	4	1	0	--	--
Fall 1954	0	44	38	8	0	0	0	0	0
Spring 1955	0	16	17	9	6	T	0	0	0
Doyle:									
Fall 1952	0	16	20	46	38	--	--	--	--
Spring 1953	0	30	42	50	26	--	--	--	--
Fall 1953	--	23	36	12	3	4	0	--	--
Spring 1954	--	22	17	14	3	2	0	--	--
Fall 1954	0	44	57	16	T	0	0	0	0
Spring 1955	0	8	16	5	T	0	0	0	0
Wells Meadow:									
Fall 1952	0	0	6	6	40	--	--	--	--
Spring 1953	Not planted								
Fall 1953	--	4	20	23	20	8	3	--	--
Spring 1954	--	0	0	17	19	8	1	--	--
Fall 1954	0	64	68	62	36	14	1	0	0
Spring 1955	0	20	16	5	5	1	T	0	0

Table 2.--Planting depths giving best bitterbrush seedling emergence

Experimental area	Fall 1952	Spring 1953	Fall 1953	Spring 1954	Fall 1954	Spring 1955
	Inches					
Flukey Spring (Modoc County)	0.5-2.0	0.5-2.0	0.5-1.5	0.5-1.0	0.5-1.0	0.5-1.0
Doyle (Lassen County)	1.0-2.0	0.5-2.0	0.5-1.0	0.5-1.5	1.0	1.0
Wells Meadow (Inyo County)	2.0	Not planted	1.0-2.0	1.5-2.5	0.5-1.5	0.5-1.0

Emergence is certainly not the final criteria for judging the success of a bitterbrush seeding. Many things happen to the seedlings after they emerge. So far, however, there does not seem to be any close relationship between seedling mortality and depth of planting. It is axiomatic that in order to achieve a successful stand of bitterbrush through artificial seeding, the planted seed must first germinate and the seedlings emerge from the soil. The depth at which the seed is planted is of the utmost importance in obtaining a high level of emergence.

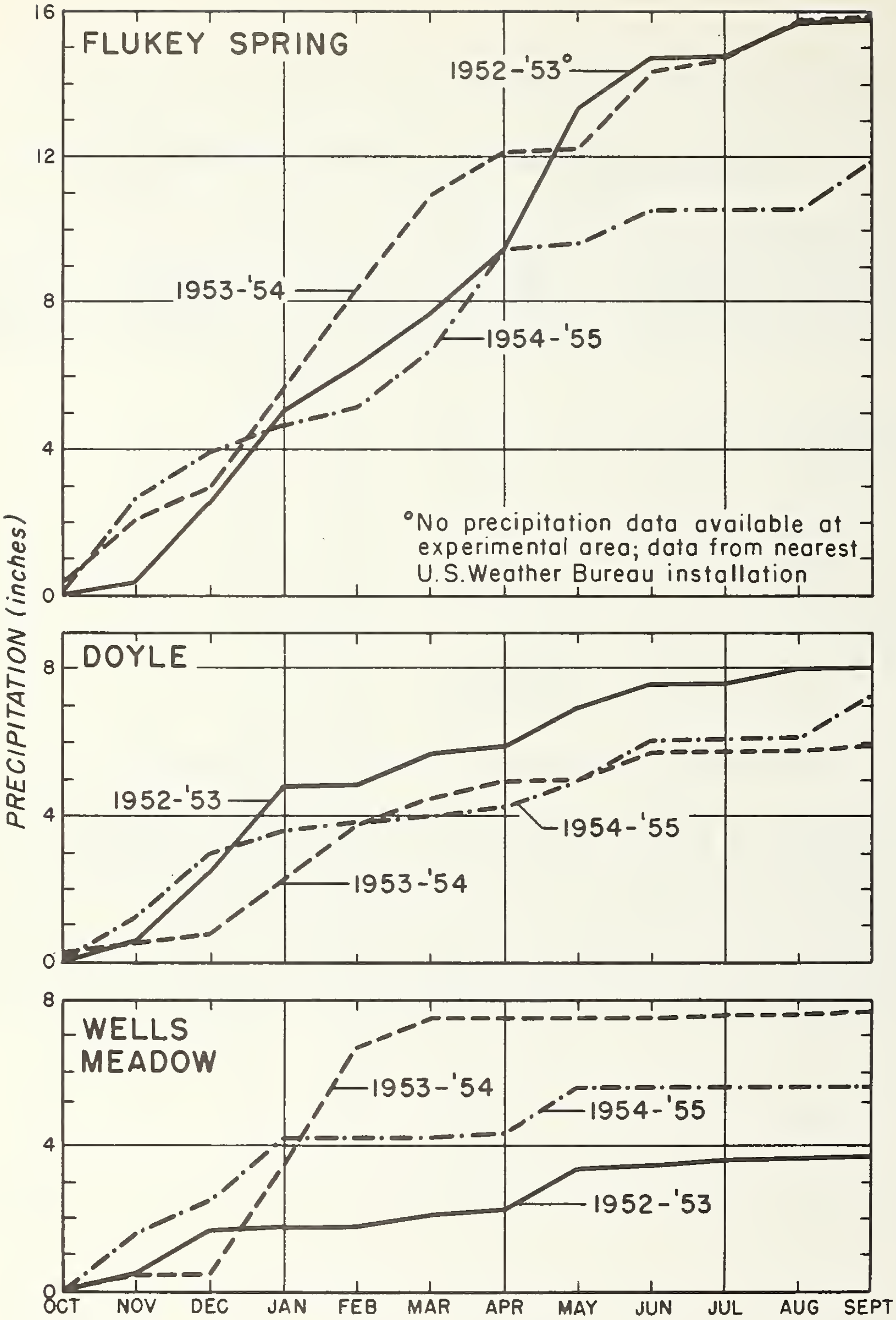

Figure 1.--Cumulative precipitation at three experimental areas, October 1952 to October 1955.